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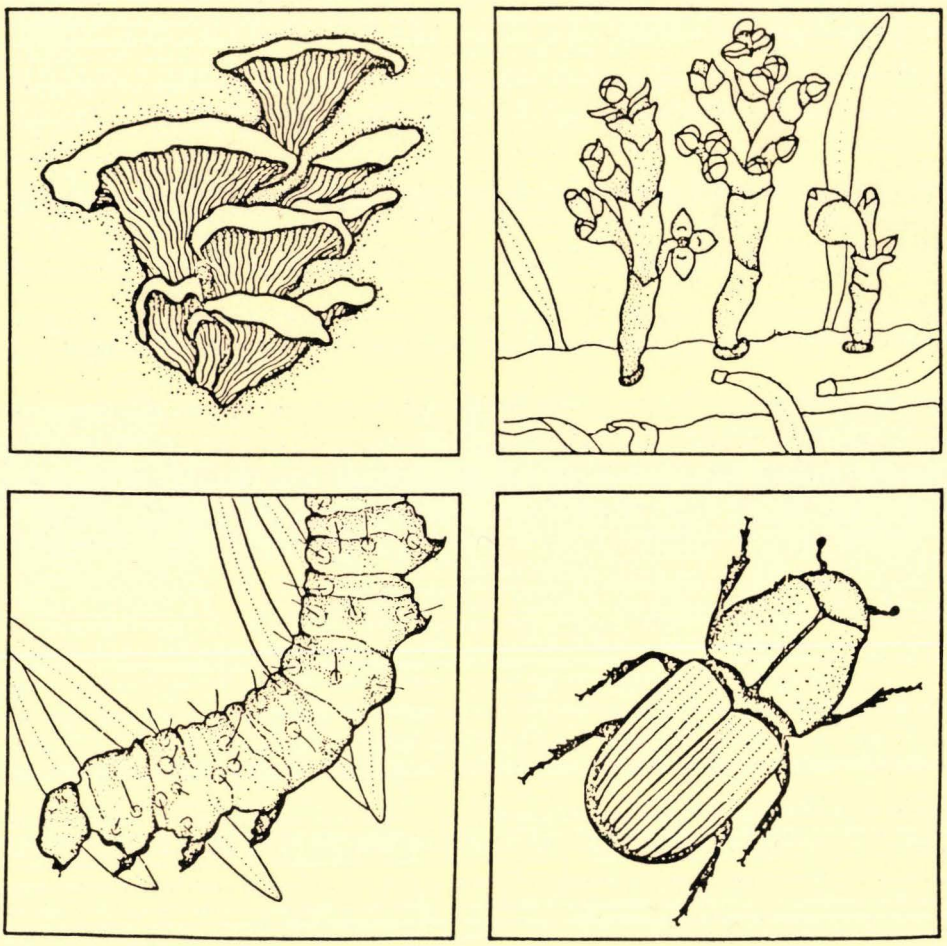

CONTROL OF THE WESTERN PINE SHOOT BORER, *EUCOSMA SONOMANA* KEARFOTT, IN SELECTED PONDEROSA PINE PLANTATIONS IN NORTHERN IDAHO AND WESTERN MONTANA

by

Jerald E. Dewey [1], *R. Ladd Livingston* [2], *Steve Kohler* [3], *and Charles Sartwell* [4]

SUMMARY

A synthetic pheromone of the western pine shoot borer, *Eucosma sonomana* Kearfott, has been used successfully as a "mating disrupter" in northern Idaho and western Montana since 1984. Infestation levels in treated ponderosa pine plantations declined from an average of 28 percent infested in 1983 to 5.5 percent by 1986. At the same time, infestation levels in the untreated check areas increased from an average of 24 percent to 30 percent from 1983 to 1986.

INTRODUCTION

Since 1983, a project has been carried out to reduce the influence of the western pine shoot borer, *Eucosma sonomana* Kearfott, in selected ponderosa pine plantations in northern Idaho and western Montana. Plantations included in this effort are those established by the Inland Empire Tree Improvement Cooperative to evaluate the growth characteristics of various tree families from stands scattered throughout the region. The plantations are now about 13 years old; an age which can be significantly impacted by the shoot borer.

The shoot borer's primary impact is on tree form and height growth and/or the development of trees with multiple tops. The larvae, by feeding inside developing shoots, cause a stunting of the growth. These anomalies mask the inherent growth capabilities of the tree.

An effective means of controlling this pest is to use a synthetic sex attractant in a technique generally termed "mating disruption" but sometimes referred to as "male confusion." The essence of this new approach to pest management is to disperse much more synthetic attractant in the insect's habitat than females naturally produce, thereby preventing male moths from finding mates. Thus, females fail to produce fertile eggs and the pest population declines.

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EXPERIMENT STATION

The objective of this project is to minimize the influence, to the extent possible, of the western pine shoot borer in these plantations so the trees' actual growth capabilities can be assessed. This was an operational suppression program aimed at reducing impacts. Thus, no attempt was made to select plantations with similar infestation levels. Detailed infestation data was only collected through 1986.

The plantations will continue to be treated annually with pheromones at least until 1990, the time of the next growth assessment.

The first 2 years of this project have been reported (Livingston et al. 1984; Dewey et al. 1985). This report describes the methods used and includes results achieved in 1985 and 1986 (years 3 and 4).

METHODS

Materials - Following the 1984 evaluation, it was found that no difference existed in effectiveness of the two commercially available pheromone blends (Dewey et al. 1985). Hence, successive control efforts have utilized the less expensive Phillips formulation, i.e. 2:3 mixture of Z-9 to E-9 dodecenyl acetate.

This material has been incorported into HERCON® LURETAPE®/WPSB by Hercon Division of Health-Chem Corporation. It is applied in such a way as to produce 8.7 grams of pheromone per acre (21.6 grams per hectare). The pheromone is sandwiched within the LURETAPE® so as to gradually be released throughout the moths' flight period (approximately 60 days). LURETAPE® strips, .63 x 60.96 centimeters (14 inch x 24 inches), spaced at 9.12-meter (10-yard) intervals, yields the desired pheromone concentrations in the air.

Treatment - The method of treatment in 1985 and 1986 followed that described by Livingston et al. 1984. The plantations treated and the treatment dates were:

Plantation	*Date Treated*	
	-1985-	*-1986-*
Condon	April 5	April 3
Lone Mtn.	April 2	March 25
Lubrecht	April 3	April 2
Meadow Cr.	April 3	--
Russell Bar	April 3	April 1
Tensed	April 2	March 24

Pheromone-baited sticky traps were placed in each plantation about 1 week prior to treatment to determine if moth flight was in progress.

Buffering with LURETAPE® strips of surrounding pine stands to reduce invasion from outside the plantation was repeated as in previous years (Dewey at al. 1985).

The Russell Bar Seed Orchard was included in the treatment in 1985 and 1986. Treatment was suspended in 1986 at the Meadow Creek test plantation due to lack of effectiveness. The suspected reason for this is the vast acreage of young pine stands that entirely surround this plantation. These stands have the capability of producing sufficient mated female moths to migrate into the test plantation nullifying the treatment effect.

Evaluation - Infestation levels were assessed in each plantation by the same specialist that evaluated the plantations in previous years. The previous year's posttreatment infestation survey serves as the next year's pretreatment population measurement. Population surveys are made in late summer or early fall when evidence of infestation is most conspicuous. Population surveys were made in each treated plantation as well as in a nearby untreated one.

In each plantation, at least 25 percent of the trees, or 500 trees (whichever came first) were evaluated for shoot borer infestation. All trees on every fourth row made up the sample. Only terminal shoots were evaluated.

An analysis of covariance was used to compare treatment means using each plantation as a replication. Abbott's formula[5] was used to adjust for natural mortality.

In addition, for those plantations with a complete data set for both treated and check plantations for 1984, 1985, and 1986, an analysis of variance was used to test differences between means using the following structure:

	Degrees of Freedom
Years - 1984, 1985, 1986	3
Plantations - Condon, Lone Mtn., Lubrecht, Tensed	4
Samples - Pre and post	2
Total degrees of freedom (one missing value)	47

RESULTS AND DISCUSSION

No moths were captured in any of the pheromone-baited traps prior to placement of the LURETAPE® in either 1985 or 1986, with the exception of Russell Bar. Climatic conditions at Russell Bar are such that moth emergence began prior to the end of March. This early moth flight may have been responsible for the nondeclining infestation at this location in 1986.

The average infestation level of terminal shoots for these plantations with accompanying check areas was reduced as a result of the treatment from 28 percent to 5.5 percent during the 3 years of treatment (Figure 1 and Appendix 2). It was reduced by 61.2 percent in 1984, another 23.6 percent in 1985, and another 20.7 percent in 1986. It is to be expected that the higher the infestation level, the higher the percent infestation reduction. It may be very difficult, if not impossible, to achieve much more of a reduction of infestation at these plantations because of immigration of already mated female moths from surrounding untreated stands. Without continuous treatment, shoot borer populations will probably return to pretreatment levels within a few years.

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[5]

$$\% \text{ control} = 100 \times 1 - \left(\frac{\text{treatment mean following control}}{\text{treatment mean before control}} \times \frac{\text{check mean before control}}{\text{check mean following control}} \right)$$

Pre- and posttreatment infestation levels and percent change are shown in Appendix 1. Results of the analysis of variance of the 1984, 1985, and 1986 data for plantations with accompanying check areas is displayed in Appendix 2. Population levels in the check areas increased or remained stable for the most part from 1983 through 1985, then showed a slight decline in 1986, while infestations in the treated plantations declined from an average of 28 percent infested in 1983, to 5.5 percent in 1986.

As expected, differences between treated and untreated plantations were the most highly significant factor compared (Appendix 3, line 14). In relation to population trends in the check areas (static to increasing), the treated areas showed a very significant declining trend (Appendix 3, line 12). Lines 7 and 8 of Appendix 3 point out a tendency for greater differences when populations are high than when they are low. This may partially explain why populations in treated plantations have leveled off somewhat.

CONCLUSIONS

From the data collected and our observations, we conclude:

1. The Phillips formulation is as effective as the more expensive "natural" mix.

2. Lateness of application can reduce treatment effectiveness.

3. Damage reduction with mating disruption is difficult to achieve in circumstances where there is substantial migration of mated females from nearby areas into the treated plantation.

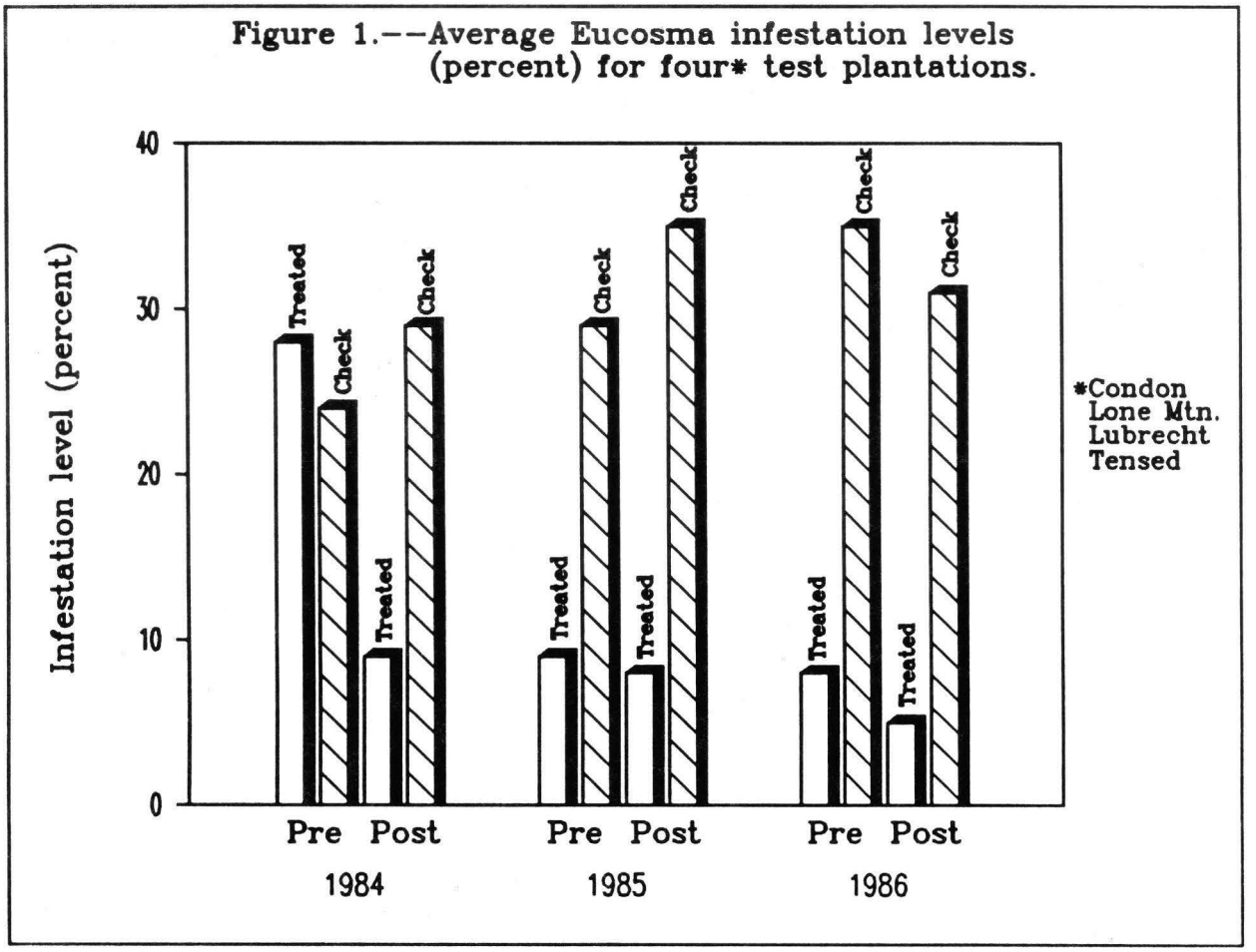
4. Where probability of mated female influx is low, repeated treatments are highly effective in reducing damage to a low level and keeping it there.

REFERENCES CITED

Dewey, Jerald E., R. Ladd Livingston, Steve Kohler, and Charles Sartwell. 1985. Control of the western pine shoot borer *Eucosma sonomana* Kearfott in selected ponderosa pine plantations in northern Idaho and western Montana. Progress Report No. 2. CFPM Rept. 85-22, USDA For. Serv., Northern Region, Missoula, MT.

Livingston, R. Ladd, Jerald E. Dewey, Steve Kohler, and Charles Sartwell. 1984. Control of the western pine shoot borer *Eucosma sonomana* Kearfott in selected ponderosa pine plantations in northern Idaho and western Montana. Progress Report No. 1. Idaho Dept. of Lands, Coeur d'Alene, Idaho. Rept. 84-5.

Figure 1.--Average Eucosma infestation levels (percent) for four* test plantations.



Appendix 1.--Infestation levels from 1983-1986.

Plantation	Acres	Pretreatment population	Posttreatment population	Change
Condon	22	* 1984 47.4	16.4	- 31.0
		1985 16.4	11.0	- 5.4
		1986 11.0	6.5	- 5.5
Condon Control	--	1984 24.9	33.1	+ 8.2
		1985 33.1	35.0	+ 2.0
		1986 35.0	34.4	- .6
Lone Mtn.	22	1983 58.8	35.8	- 23.0
		* 1984 35.8	16.1	- 19.7
		1985 16.1	14.0	- 2.1
		1986 14.0	9.0	- 5.0
Lone Mtn. Control	--	1984 29.2	40.8	+ 11.6
		1985 40.8	41.6	- .8
		1986 41.6	33	- 8.6
Lubrecht	24	* 1984 18.1	2.4	- 15.7
		1985 2.3	.9	- 1.5
		1986 .9	.6	- .3
Lubrecht Control	--	1984 20.9	18.2	- 2.1
		1985 18.2	19.7	+ 1.5
		1986 19.7	--	--
Meadow Creek	23	1983 36.5	32.3	- 4.2
		* 1984 32.3	27.1	- 5.3
		1985 27.1	30.3	+ 3.2
		** 1986 30.3	37.5	+ 7.2
Meadow Cr. Control	--	1984 45.6	48.2	+ 2.6
		1985 48.2	50.4	- 2.2
		1986 50.4	43.3	- 7.1
Missoula Nursery	13	1983 35.0	30.0	- 5
		* 1984 30.0	6.0	- 24.0
Russell Bar	12	1985 12	6	- 6
		1986 6.0	7.5	+ 1.5
Tensed	22	1983 50.9	14.7	- 36.2
		* 1984 14.7	1.6	- 13.1
		1985 1.6	6.0	+ 4.4
		1986 6.0	6.0	0
Tensed Control	--	1984 21.8	23.6	+ 1.8
		1985 23.6	42.0	+ 18.4
		1986 42.0	23.2	- 18.8

* In 1984, two pheromone formulations were evaluated in each plantation. Because there was no statistical difference between population levels, an average of the two is used on this analysis.

** Treatment was discontinued.

Appendix 2.--Plantation infestation levels (percent) by year, plantation, treatment and sample (pre or post)

		1984		1985		1986	
Treatment	Plantation	Pre	Post	Pre	Post	Pre	Post
Treat	Condon	47.4	16.4	16.4	11.0	11.0	6.5
Treat	Lone Mtn.	35.8	16.1	16.1	14.0	14.0	9.0
Treat	Lubrecht	18.1	2.4	2.4	0.9	0.9	0.6
Treat	Tensed	10.7	1.6	1.6	6.0	6.0	6.0
Group Mean		28.0	9.1	9.1	8.0	8.0	5.5
Check	Condon	24.9	33.1	33.1	35.0	35.0	34.4
Check	Lone Mtn.	29.2	40.8	40.8	40.8	40.8	33.0
Check	Lubrecht	20.9	18.2	18.2	19.7	19.7	--[1]
Check	Tensed	21.8	23.6	23.6	42.0	42.0	23.2
Group Mean		24.2	29.0	29.0	34.4	34.6	30.2

[1]Missing value.

Appendix 3.--Analysis of variance table by year, plantation, treatment and sample.

Line #	Source of variation	DF	SS	MS	F	Sig. of F
1	Year	2	112.38	56.29	1.38	.320
2	Plantation	3	1,989.17	663.06	16.37	.003
3	Error 1	6	242.93	40.40		
4	Treatment by year	2	654.44	327.22	14.83	.005
5	Plantation by treatment	3	193.59	64.53	2.92	.122
6	Error 2	6				
7	Year by sample	2	187.40	93.70	3.13	.117
8	Plantation by sample	3	35.71	11.90	.39	.759
9	Error 3	6	179.31	29.88		
10	Treatment by year by sample	2	429.65	214.65	9.482	.020
11	Plantation by treatment by sample	3	96.05	32.01	1.413	.342
12	Treatment by sample	1	222.88	222.88	9.837	.026
13	Sample	1	119.30	119.30	5.266	.070
14	Treatment	1	4,079.18	4,079.18	180.05	.000
15	Error 4	5	113.27	22.65		
16	Corrected	46[1]	8,655.26			

[1]One missing value.